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Beyond Surveillance: Towards the Management of Feral Swine Diseases

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ABSTRACT: Feral swine distribution and densities are greatest in Texas and related swine disease issues have emerged in a number of fronts. Beyond the standard surveillance protocols, the Texas Cooperative Wildlife Service program has initiated several feral swine projects to identify, contain or eliminate feral swine diseases and pathogens. This paper discusses these projects, the supportive data to quantify disease management and the near-term trend in disease management.

Key Words: disease surveillance, disease management, feral swine

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INTRODUCTION

Feral swine pose a disease risks to wildlife, domestic livestock and humans (Davis 1993, Miller 1993, Choquenot et al. 1996). To date, significant resources have been directed at elimination of livestock disease and to the surveillance of disease agents in feral swine populations in the United States. Surveillance strategies have been developed to maximize the likelihood of detecting foreign or domestic livestock diseases.

The response to a disease agent is typically dependent upon the risk the pathogen poses to various resources. Table 1 provides a current list of disease pathogens for which the Texas Cooperative Wildlife Services program has conducted surveillance.

Because feral swine diseases potentially cross traditional lines of responsibility between public health as well as domestic livestock and wildlife, management of these pathogens are likely to be more complex than most livestock disease management situations. For example, *Brucella suis*, has been identified in numerous feral swine populations. This pathogen has

Table 1: Feral swine disease pathogens investigated through surveillance in Texas.

| Pathogen | Presence in Feral Swine in Texas |
|---|----------------------------------|
| <i>Brucella suis</i> | + |
| <i>Brucella abortus</i> | + |
| Pseudorabies | + |
| Porcine Reproductive and Respiratory Syndrome | + |
| <i>E. coli</i> | + |
| Toxoplasmosis | + |
| Trichinella | + |
| H1 & H3 viruses | + |
| Classic Swine Fever | - |
| Foot and Mouth Disease | - |
| <i>Mycobacterium bovis</i> | - |

potential impacts to both human health and livestock, yet no unified approach to management of the pathogen has been identified. The management of rabies in wildlife populations is similar. While individual campaigns against specific rabies strains have been implemented, there is yet to be a unified approach to all strains of rabies.

An important distinction between typical wildlife vectored disease management and feral swine diseases lies in the fact that feral swine are also an invasive species with significant environmental impact. Therefore the management of feral swine diseases is likely to contain a different decision matrix than traditional disease management.

For purposes of this discussion, we categorize diseases and pathogens into three broad categories: livestock diseases, zoonotic diseases and environmental diseases. It should again be emphasized that some pathogens may impact multiple categories.

Livestock diseases can affect production, trade or both. Targeted surveillance is conducted for the detection of foreign animal diseases such as Classic Swine Fever (CSF), and Foot and Mouth Disease (FMD), while opportunistic surveillance is conducted to monitor the presence of endemic diseases including Brucella, pseudorabies (PRV), or porcine reproductive and respiratory syndrome (PRRS).

The management of a number of zoonotic diseases such as Brucella, toxoplasmosis, and trichinella, has thus far been predominantly focused on human surveillance and interdiction. No field activities have been initiated for the management of human disease pathogens.

Environmental diseases occur from the potential for disease pathogens to affect natural systems or to impact wildlife. For example, *E. coli* levels in many watersheds exceed the EPA standards for the Clean Water Act compliance. Additionally, strains of the bacteria found in feral swine may be pathogenic to humans and wildlife (USDA-WS, unpublished data). Environmental diseases can also impact wildlife. At least one endangered Florida panther (*Puma concolor coryi*) was reported to have succumbed to PRV (Glass et al. 1994).

The management of feral swine diseases in most cases depends upon the severity of the disease, potential economic impacts and costs, and availability of effective strategies. We suggest that neither traditional livestock disease management nor current wildlife disease management techniques are sufficiently effective for management of feral swine diseases. Feral swine disease management efforts require changes in thinking regarding the role of disease

surveillance, and development of models to monitor disease progression within a feral swine population. GIS data collection and management tools are necessary to effectively develop a site specific feral swine disease management program. Understanding variation in population dynamics to determine if a feral swine population is closed or open to immigration and emigration, as examples, influences the role of density dependence in diseases in an animal with strong herd instincts. All these factors create the need for a better understanding of the logistics necessary to carry out an effective management strategy.

THE ROLE OF SURVEILLANCE

Current surveillance techniques are designed to detect the presence or absence of a disease in feral swine. In some cases, where feral swine populations are newly established or isolated from other swine, disease surveillance may also serve as a predictor of prevalence. However, in open populations, surveillance data represent the detection of the disease pathogen and likely do not represent true prevalence. In some cases, once a pathogen is identified in an area, additional surveillance data may no longer be needed from that location.

Managing feral swine diseases will likely require the collection of accurate prevalence data. Since prevalence is, in part, based upon the percentage of a population affected with a particular disease at a given time, we must carefully define the population. For a particular event, a population may need to be defined geographically, or may be a subset of a larger feral swine population. For example, *Brucella* is commonly spread through breeding. Thus, the presence of gilts having not reached puberty may not yield an accurate picture of the true prevalence in the population at a specific time period.

Similarly, disease managers must understand the implications of positive and negative prevalence data. The presence of antibodies in feral swine serum indicates either a current infection or prior exposure to and recovery from a disease pathogen. While the focus of detection surveillance may be to discover the presence of the pathogen, it does little to describe the timeline of the outbreak nor does it indicate the level of mortality caused by the pathogen. Changes in

prevalence data may indicate the effects of a management program in a closed population, but without additional data on density, immigration and special relationships, changes in prevalence in an open population has limited utility.

Finally, in open populations surveillance during management requires broad boundaries to determine the extent of the disease and to minimize spreading. In a closed population, surveillance needs to track population levels as well as disease prevalence to develop models to ensure success.

DEVELOPMENT OF MANAGEMENT STRATEGIES

The application of one or more traditional disease management strategies for feral swine diseases may need to be examined with full recognition of the species invasive status. Traditional vaccine programs, such as the highly successful oral rabies vaccine programs in Texas, may not be appropriate for feral swine. Healthy feral swine still contaminate water systems with *E. coli*, depredate crops and endangered wildlife and impact ecosystem health. Depopulation of most species is often controversial and managers may expect some obstacles to surrounding feral swine depopulation efforts and specific methods. Depopulation may be possible in closed populations of feral swine, but in large, open populations, where considerable risk occurs, depopulation models may actually mirror source/sink dynamics as feral swine reoccupy the controlled areas.

Exclusion of feral swine may be necessary to protect specific resources, but may have limited influence on the presence or spread of a given disease. Inclusion, by constructing swine-proof fences around infected portions of an open population, may be attractive but field experience indicates that significant resources are needed to maintain the fence (WS, unpublished data). A single breach of the fence would be considered a disease breach and additional surveillance and a new perimeter may need to be constructed.

Reproductive control using various methodologies tends to be viewed as attractive and humane alternative to lethal means. However, in open populations, reproductive control tends to be ineffective. Successful contraception of

greater than 80% of breeding age females in a population is necessary for negative population growth, which is likely infeasible in all but small, isolated populations. Even with negative population growth, disease pathogens exist and pose a risk.

UNDERSTANDING THE DISEASE IN NATURE

Much of what is known about feral swine diseases is inferred from domestic swine data. For example, PRV affects domestic swine production by causing death of piglets less than 3 weeks of age and abortions in pregnant females. As a herpes virus, PRV appears to circulate through every animal in a confinement environment. However, in the wild, Texas data suggest that outbreaks of PRV infectivity circulate as an epizootic rather than as an enzootic condition. In a single case with adequate surveillance, epizootic outbreaks of infectivity appear to cycle in two-year intervals, but the risk of enzootic PRV between outbreaks is not understood. Similarly, some diseases which can be debilitating in domestic swine may be minor or even asymptomatic in feral swine.

Understanding the epidemiology of the disease in feral swine is critical to selecting the appropriate management strategy. Modeling of feral swine populations and disease outbreaks is necessary before an incident occurs to help managers understand the risks associated with feral swine.

LOGISTICS

While the selection of effective strategies should be based upon scientific understanding of the risks and epidemiology of the disease, logistical demands must also be considered. For example, while fencing may be an attractive solution, maintenance of the fence must be included in the implementation costs. Those potential expenses can greatly be influenced by challenges such as river crossings or areas where human traffic may affect the integrity of the fence.

Removal strategies rely on either regulatory authority or cooperative landowners. Feral swine have different legal status in various states and no federal regulatory authority exists, short of declarations of emergencies. Considering the potential severity of feral swine disease out-

breaks, a matrix of existing and potential regulatory authorities needs to be examined before a disease outbreak occurs. Communication content and delivery methods should be developed in advance to inform stakeholders should regulatory authority be necessary to respond to a disease outbreak.

Depopulation on a large scale is also problematic. Aerial shooting is very effective for removing large numbers of feral swine. However, costs per swine removed tends to increase exponentially as efforts progress when fewer animals are present as well as changes in their behavior can occur with the activity. Depopulation has been successful on Santa Rosa Island (Lombardo and Faulkner 2000) and Santa Catalina Island (Schuyler et al. 2002), the latter successful only after compartmentalization of the island with fencing and systematic hunting with dogs. The effective use of dogs may be prohibited if the pathogen affects either dogs or humans.

Current field experience indicates that critical resources may not be readily available for widespread depopulation. For example, the nationwide availability of 00 Buck shotgun shells as well as popular rifle ammunition may be limited by commercial and other demands. It may become necessary to stockpile an emergency supply of ammunition in order to effectively respond to a feral swine disease outbreak. Similarly, the availability of fencing materials and the adequacy of emergency contracting for fence construction may be lacking. There are no feral swine vaccines registered and the development of toxicants is limited to a single effort. If either biologics or toxicants are to be considered as a strategy for disease management, these research needs should be addressed.

GIS REQUIREMENTS

GIS databases can serve as a critical tool for the tracking and management of diseases. However, little thought has been given to development of GIS tools for feral swine disease re-

sponse. As an example, most wildlife populations are thought to be spread across the landscape in uniform patterns. However, feral swine exist in loose family groups and show a strong fidelity to water (USDA-NWRC, unpublished data) and riparian corridors and they appear to avoid certain man-made features (Campbell, pers. comm). Distribution of vaccines or toxicants as a potential disease response would need further development of GIS databases related to feral swine distribution to be effective. Similarly, identification of habitat features that lend themselves to feral swine concentrations could yield productive models for feral swine removal. Identification of water sources during a drought, for example, could predict areas of disease transmission as well as concentrations of feral swine. While the depth of contributions of GIS to the management of feral swine diseases is at this point limited, we suggest this technology represents tremendous potential for this purpose.

CONCLUSIONS

Far from reaching conclusions, we wish only to open a dialog on the steps necessary to manage a feral swine disease outbreak. In some cases, such as a limited disease and a closed population, current response systems and methodology are adequate. In others, we are certain that disease response protocols are inadequate and strategies for addressing them are untested. Table top exercises, involving wildlife disease and management officials are necessary to develop an appropriate suite of strategies. Current feral swine removal programs provide an opportunity to test and monitor populations to develop the data necessary to respond. Logistical exercises need to be conducted to assess the need for stockpiling critical components and biologics to respond. Given that feral swine have been present in the United States for over 400 years, not being prepared to respond to an emergency is inexcusable.

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